

## THREE NEW SPECIES OF *HELICOPSYCHE* FROM VIETNAM (TRICHOPTERA: HELICOPSYCHIDAE)

PATRICIA W. SCHEFTER<sup>1</sup> AND KJELL ARNE JOHANSON<sup>2</sup>

<sup>1</sup>Centre for Biodiversity and Conservation Biology, Royal Ontario Museum,  
Toronto, Ontario, Canada M5S 2C6

<sup>2</sup>Swedish Museum of Natural History, P.O. Box 50007,  
S-104 05 Stockholm, Sweden

*Abstract.*—Three new species of *Helicopsyche* are described from Vietnam: *Helicopsyche khemoiensis* NEW SPECIES, *Helicopsyche azunensis* NEW SPECIES and *Helicopsyche dacklestensis* NEW SPECIES. *Helicopsyche khemoiensis* is most closely related to *H. coreana* Mey, the two species comprising the subgenus *Galeopsyche*. *Helicopsyche khemoiensis* is distinguished from *H. coreana* by the shape of the gonocoxite and armature of tergite X. Immature stages of *H. khemoiensis* are described. *Helicopsyche azunensis* and *H. dacklestensis*, subgenus *Helicopsyche*, are most closely related to *Helicopsyche chrysothoe* (Schmid), *H. xenothoe* (Schmid) and other species characterized by four-segmented maxillary palps, absence of mesoscutal warts and distally hooked gonocoxal secondary branch. *Helicopsyche azunensis* and *H. dacklestensis* are distinguished from other species in that group by the presence on the phallus of large endothecal sclerites.

*Key Words.*—Insecta, Trichoptera, Helicopsychidae, *Helicopsyche*, Vietnam, NEW SPECIES.

Biologists from the Centre for Biodiversity and Conservation Biology at the Royal Ontario Museum, Toronto, are collecting insects, reptiles and amphibians, and small mammals from the forests of Vietnam in an effort to determine the diversity and uniqueness of their faunas. Deforestation is proceeding rapidly and environmentalists are racing to find areas of high endemism which should be protected from further degradation. Collections brought back to the Museum for identification have yielded a number of species unknown to science. Terrestrial and aquatic insect collections, including Trichoptera, are particularly rich in undescribed species. This paper describes three new species of *Helicopsyche* (Trichoptera) from streams in Vietnam.

Originally described as a pulmonate snail (Say 1821), the larva of the caddisfly *Helicopsyche* builds a dextrally coiled sand grain case within which it grazes periphyton from rock surfaces. The case which bears an uncanny resemblance to that of a snail provides protection from predators and its shape enhances the larva's ability to maintain position in the current of a freshwater lotic habitat; its sturdy construction resists crushing, and permits the larva to burrow deeply into the substrate (Williams et al. 1983).

The family Helicopsychidae occurs in all faunal regions and is most diverse in the Oriental and Neotropical regions. Of the nearly 180 species which have been described approximately 150 are in the genus *Helicopsyche*. Only two species of *Helicopsyche*, *H. coreana* Mey from North Korea and *Helicopsyche azwudschgal* Malicky from northern Vietnam were previously known as adults from the East Asian Subregion (sensu Banarescu 1992) (central and northern Vietnam, China, Korea, the Japanese archipelago, Sakhalin Island, Taiwan, Hainan); *Helicopsyche yamadai* Iwata from Japan was described from larval material and undescribed larvae of the family were also reported from Hong Kong (Dudgeon 1988). The

three species described in this paper, *Helicopsyche khemoiensis* Schefter & Johanson NEW SPECIES, *Helicopsyche azunensis* Schefter & Johanson NEW SPECIES and *Helicopsyche dacklestensis* Schefter & Johanson NEW SPECIES substantially increase the known helicopsychid fauna of the subregion. The neighboring South Asian Subregion (sensu Banareescu 1992) (southwestern Vietnam, Thailand, Malaysia, Laos, Myanmar, the Indonesian archipelago, southern India and Sri Lanka) harbours approximately 50 species of *Helicopsyche*, sensu lato (Malicky & Chantaramongkol 1993; Schmid 1993; Malicky 1994, 1995; Johanson 1998).

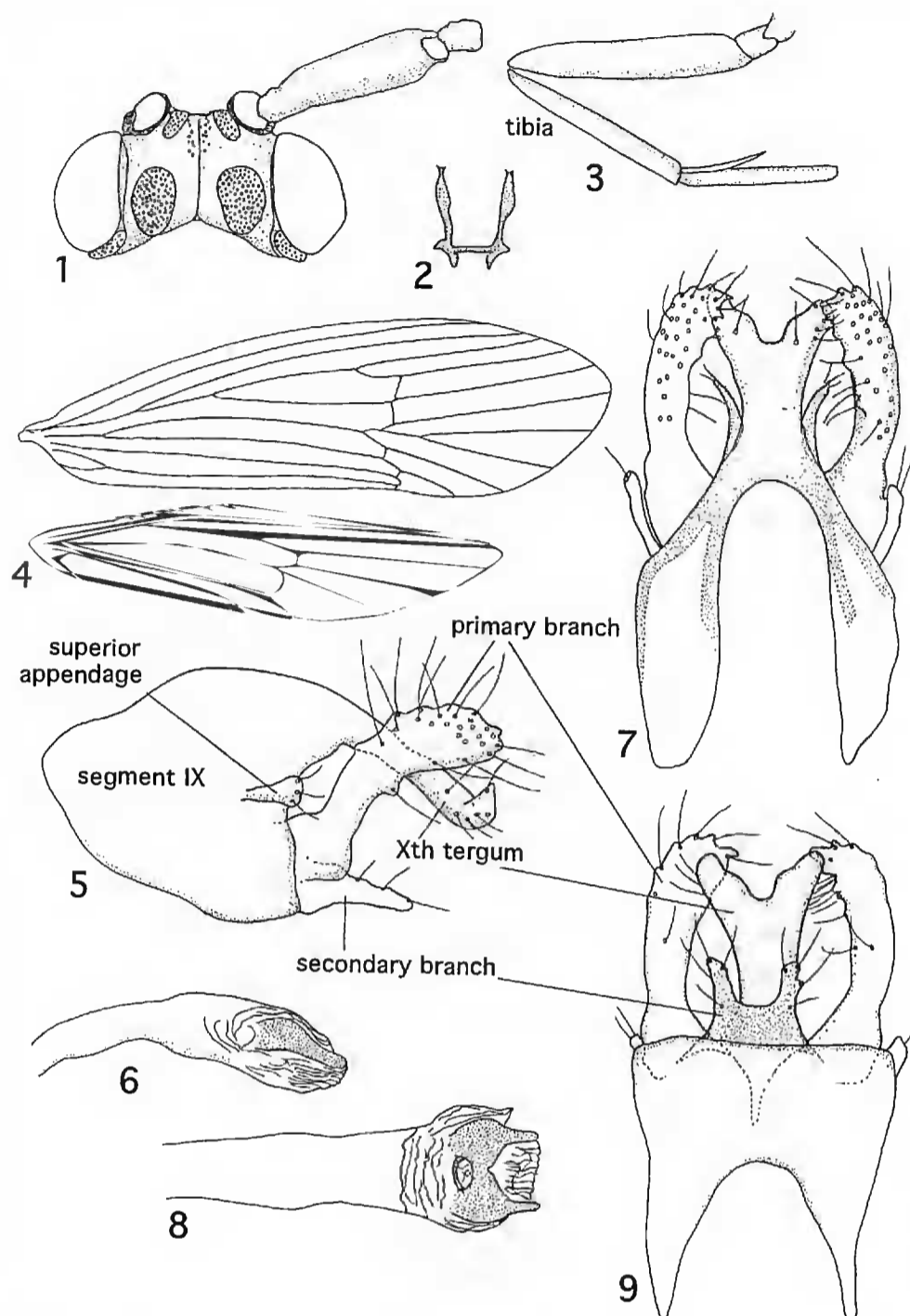
Morphological terms used in this paper are adopted from Johanson (1998). Types are deposited in the Royal Ontario Museum, Toronto, Canada.

*HELICOPSYCHE KHEMOIENSIS* SCHEFTER AND JOHANSON, NEW SPECIES  
(Figs. 1–26)

*Types*.—Holotype, male; VIETNAM. *NGHE AN*: West of Con Cuong, Khe Moi Forestry Camp, 28 Oct 1994, D. C. Currie, ROM946112, coal oil lantern, tropical forest, Khe Moi River margin. Paratype: female, same data as holotype. Paratypes, immatures: VIETNAM. *NGHE AN*: ca. 25 km SW of Con Cuong, Khe Moi River Forestry Camp, 6 June 1995, Brad Hubley, ROM956170, small stream 100 m upriver of camp, tropical forest edge, 18°56'N, 104°49'E (2 pupae, 2 larvae).

*Description*.—Male. Head (Fig. 1): postantennal warts small, ovoid; cephalic warts large, ovoid; eyes large, diameter equal to length of head (Fig. 1); antenna with scape swollen, four and one half times length of pedicel; pedicel and first flagellomere subequal, subsequent four segments graduated in length, remainder equal to fifth; tentorium (Fig. 2) with anterior arms subparallel, distally slightly expanded, short posterior arms and broad tentorial bridge; maxillary palps with segments 1 and 2 subequal, apical segment with long setae dorsally. Pronotum with one pair of setal warts. Legs: spur formula 1,2,4, apical tibial spur of anterior leg slightly longer than one half length of first tarsal segment (Fig. 3). Wings (Fig. 4): fore wing length 4.6 mm, forks 1,2 and 3 present; fork 1 originates on distal one third of Dc; R<sub>2</sub> subequal to Dc; A<sub>1</sub> and A<sub>2</sub> fused basally, A<sub>1+2</sub> fused with Cu<sub>2</sub> without reaching posterior wing margin; hind wing 3.7 mm, with 16 hamuli. Abdomen with small, pointed VIth sternal process. Genitalia: segment IX, lateral view (Fig. 5), anteriorly nearly oval, with weakly developed apodemes; dorsally reduced to a sclerous transverse bridge (Fig. 7); in ventral view broad and deep (Fig. 9); gonocoxite divided into large primary and short secondary branch; in lateral view (Fig. 5) primary branch slender, arcuate; dorsal and ventral margins subparallel; secondary branches fused ventromesally forming shelf-like star shaped plate (Fig. 9); superior appendage inserted mesally, directed posteriad, clavate in lateral view (Fig. 5); Xth tergum depressed in lateral aspect, apices hooked dorsally; in dorsal view (Fig. 7) apices divergent, separated by V-shaped notch approximately one fourth length of segment, with short lobate lightly sclerous lateral processes inserted near base of tergum; macrosetae absent. Phallus slightly arcuate (Fig. 6), apically expanded, with bifurcate sclerous process inserted dorsally in endotheca (Figs. 6 and 8).

*Female*.—Head: eyes smaller than in male; cephalic warts small, round; antenna with scape not swollen, four and one half times length of pedicel, pedicel shorter than first and subsequent flagellomeres. Spur formula 1,2,4; apical tibial spur of foreleg one third length of first tarsal segment. Wings (Fig. 10): fore wing length 5.6 mm; venation as in male, except Dc longer than M<sub>2</sub>; A<sub>1+2</sub> reaches posterior wing margin at some distance before Cu<sub>2</sub>; hind wing length 3.7 mm, with 19 hamuli; venation as in male, apex more acuminate than in male. Abdomen with short VIth sternal process, rounded in ventral view (Figs. 11 and 15). Sternite VIII with row of stiff, clear setae on apical margin. Genitalia: in lateral view (Fig. 12) segment IX with small group of ventrolateral setae, deep incision between the IXth and Xth segments includes the posterior vaginal opening; Xth segment with setae arranged along dorsal margin of dorsal branch; dorsal branches broad and slightly curved ventrad; in ventral view (Fig. 14) ventral branch of segment X very small, external part of gonopods IX narrow, arcuate;

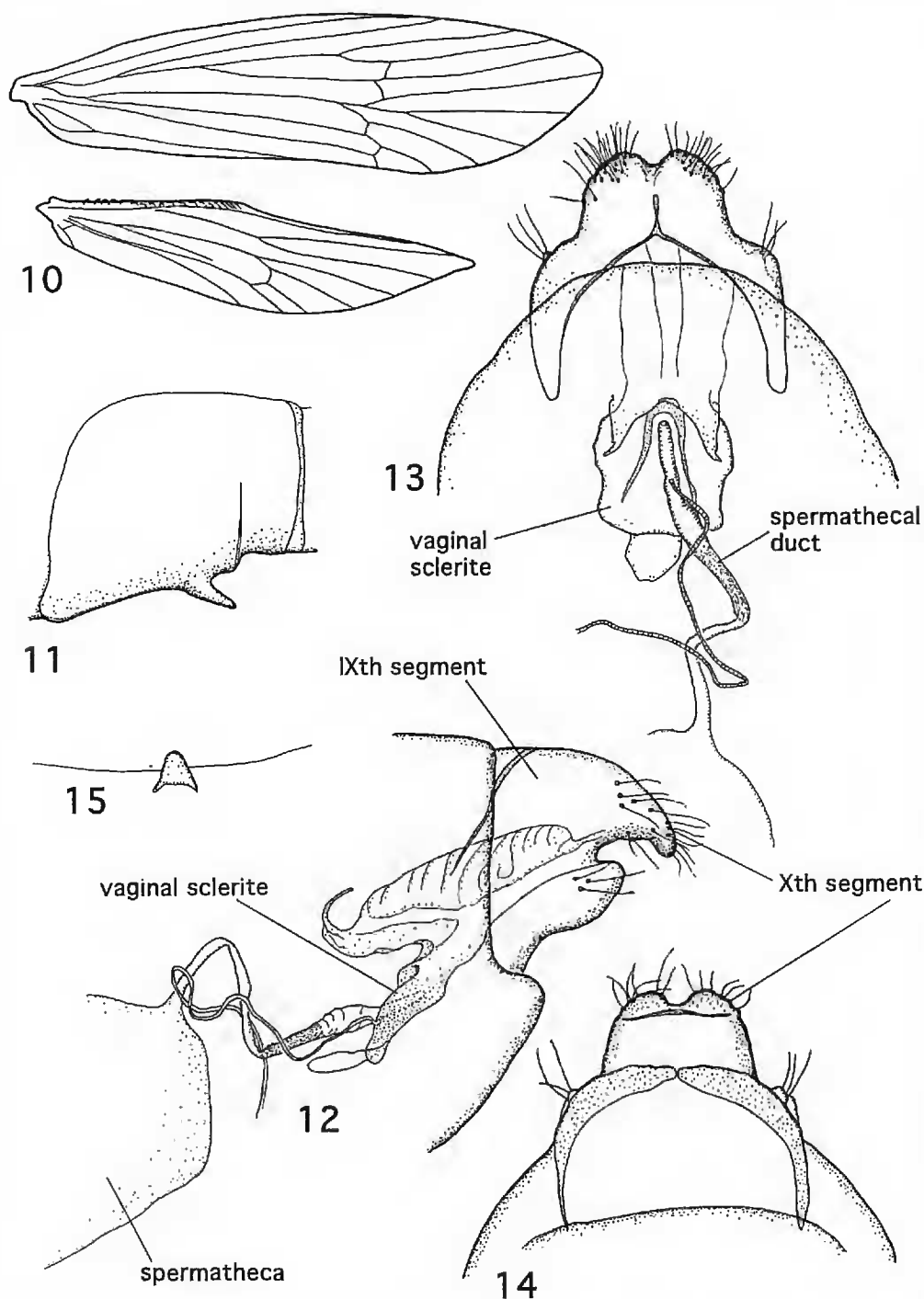


Figures 1–9. *Helicopsyche khemoiensis* (male).

- Figure 1. Head, dorsal view.  
 Figure 2. Tentorium, dorsal view.  
 Figure 3. Fore leg.  
 Figure 4. Wings.  
 Figure 5. Genitalia, lateral view.  
 Figure 6. Phallus, lateral view.  
 Figure 7. Genitalia, dorsal view.  
 Figure 8. Phallus, dorsal view.  
 Figure 9. Genitalia, ventral view.

spermathecal sclerite subquadrate; spermathecal duct with anterad-oriented microtrichia at midsection (Figs. 12 and 13).

*Larva*.—Head (Figs. 16–18): light tan with six darker spots on lateral surface, three or four minute setae posterolaterally (Figs. 16 and 17, setae 19,20,21); dorsally with dark spots scattered on surface, and postocular spot with several long setae (setae 13–16); frontoclypeus with characteristically shaped dark figure on posterior surface; ventrally unicolorous with pair of dark spots near postoccipital margin (Fig. 18). Thorax (Fig. 19): pronotum with anterior margin bearing large sharp spine-like setae; dorsally with scattered setae each surrounded by a dark spot; propleuron forming right angle, tipped by stout seta (Fig. 20). Legs: foreleg (Fig. 20) with long setae laterally on coxa, long ventral setae on trochanter and femur; mid leg (Fig. 21) and hind leg (Fig. 22) with thin setae laterally on coxa and



Figures 10–15. *Helicopsyche khemoiensis* (female).

Figure 10. Wings.

Figure 11. VIth sternal process of abdomen, lateral view.

Figure 12. Genitalia, lateral view.

Figure 13. Genitalia, dorsal view.

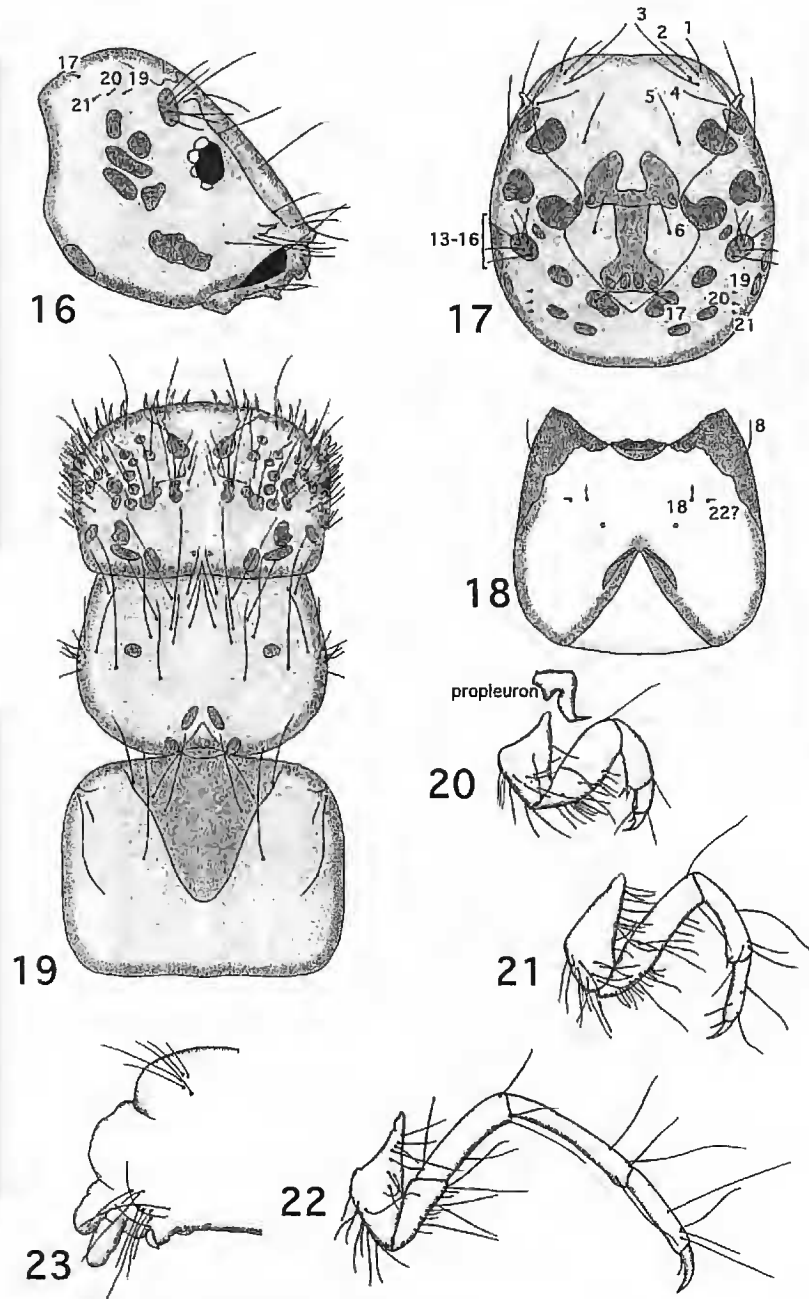
Figure 14. Genitalia, ventral view.

Figure 15. VIth sternal process of abdomen, ventral view.

ventrally on trochanter. Abdomen (Fig. 23) with small group of setae dorsolaterally on segment IX; long setae dorsad of anal prolegs on segment X; abdominal gills absent; anal gills form pair of expanded lobes; anal claw minute with many teeth. The larval case is similar to that illustrated by Wiggins (1996a).

Pupal case: anterior enclosure (Fig. 26) of densely woven silk for 75% of surface; the inner, ventral quadrant with several open bands bearing transverse strands of silk. Pupa: pupal mandibles and hook-plates as illustrated by Wiggins (1996b, fig. 17–87). Segment IX with long setae; two pairs dorsolateral, two pairs lateral and two pairs ventrolateral; anal appendages, lateral view (Fig. 24) short, angled dorsad, with two pairs long setae posteriorly and six pairs ventrally; in ventral view (Fig. 25) oriented posteriad; the ventral setae in two longitudinal rows.

*Diagnosis.*—Males of *H. khemoiensis* can be separated from closely related *H. coreana* by the star-shaped gonocoxal plate formed by the fused secondary



Figures 16–23. *Helicopsyche khemoiensis* (larva).

Figure 16. Head, lateral view.

Figure 17. Head, dorsal view.

Figure 18. Head, ventral view.

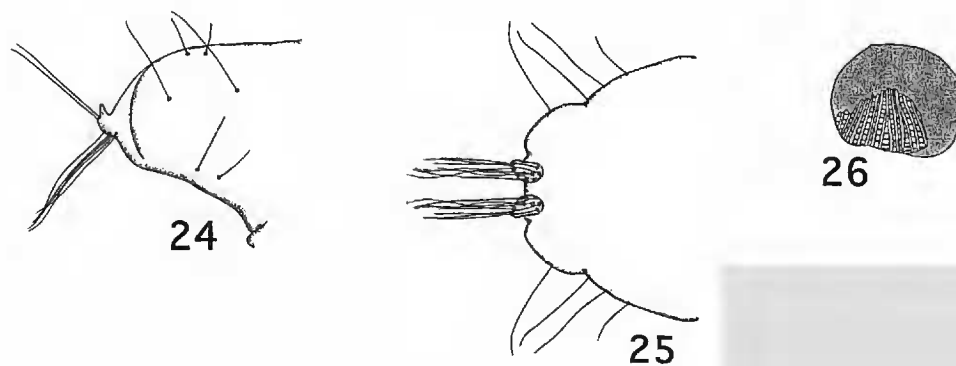
Figure 19. Thorax, dorsal view.

Figure 20. Propleuron and fore leg, anterior view.

Figure 21. Mid leg, anterior view.

Figure 22. Hind leg, anterior view.

Figure 23. Abdominal segments IX and X, lateral view.



Figures 24–26. *Helicopsyche khemoiensis* (pupa).

Figure 24. Segment IX and anal appendages, lateral view.

Figure 25. Segment IX and anal appendages, ventral view.

Figure 26. Pupal case membrane.



branches of the gonocoxite; by the Xth tergum which lacks megasetae, is shallowly bifurcate and divergent apically, hooked dorsally and which bears short baso-lateral processes. Females are recognized by the acuminate hind wing, the short rounded VIth sternal process and by the large dorsal process of the Xth segment which curves ventrad concealing the small ventral branch.

*Etymology.*—*khemoiensis*, refers to river from which species was collected.

*Material examined.*—see Types.

*HELICOPSYCHE AZUNENSIS* SCHEFTER AND JOHANSON, NEW SPECIES  
(Figs. 27–33)

*Types.*—Holotype, male: VIETNAM. *GIA LAI*: An Khe Dist; Tram Lap, Azun R., 2 km NW on trail from forestry building, 17 Jun 1996, D.C. Currie, J. Swann, ROM 961056, UV light, at rainforest edge/coffee plantation, 14°27' N, 108°33' E.

*Description.*—Male. Head (Fig. 27): antennae with lobate scape about 2× length of pedicel, 1st flagellomere as long as pedicel; eyes very large; interantennal warts as long as scape breadth, spherical; cephalic warts large, ovoid, laterad of elevated, triangular vertex; maxillary palps 4-segmented, the basal two segments together longer than labial palp. Legs: spur formula 1,2,4; fore leg spur longer than first tarsal segment. Pronotum with 2 pairs setal warts. Wings (Fig. 28): fore wing length 3.0 mm; forks 1,2,3 and 5 present; fork 1 originating on distal one third of Dc, R<sub>2</sub> subequal to Dc, A<sub>1</sub> and A<sub>2</sub> form basal loop, A<sub>1+2</sub> reaches wing margin close to Cu<sub>2</sub>; hind wing 2.3 mm, with 14 hamuli. Abdomen with small VIth sternal process. Genitalia: segment IX in lateral view (Fig. 29) subtriangular, with well developed lateral apodeme; narrow ventrally (Fig. 31); anterior margin ogival in dorsal view (Fig. 30); gonocoxite with large primary and small secondary branch; primary branch in lateral view (Fig. 29) with dorsal margin gently concave, apically hatchet-shaped; secondary branch slender, arcuate with slight apical hook (Fig. 31); superior appendage originating dorsally on segment nine, directed ventrad, clavate in lateral view; Xth tergum depressed in lateral view, in dorsal view (Fig. 30) bifurcate for one half length, divided into two tapering processes; macrosetae absent. Phallus thick, slightly curved ventrad (Fig. 32), dorsoapical membranous part of endotheca bifurcate, lobate, with a pair of slender sigmoid processes each with a small lateral tooth (Figs. 32 and 33).

*Female and immature stages.*—Unknown.

*Diagnosis.*—*Helicopsyche azunensis* is most closely related to *H. chrysothoe* (Schmid) and can be separated from it and other species with 4-segmented maxillary palps by the following characters: gonocoxite lacking an internal branch (present in *H. chrysothoe*); with hatchet-shaped primary branch longer than the tapered slightly notched secondary branch (in most other species of this group the secondary branch is strongly notched); lobate Xth tergum lacking macrosetae or notches (in other species the Xth tergum is acuminate and frequently notched apically); and phallus with a pair of stout sigmoid sclerous processes each with a subapical tooth (these do not occur in other species in this group).

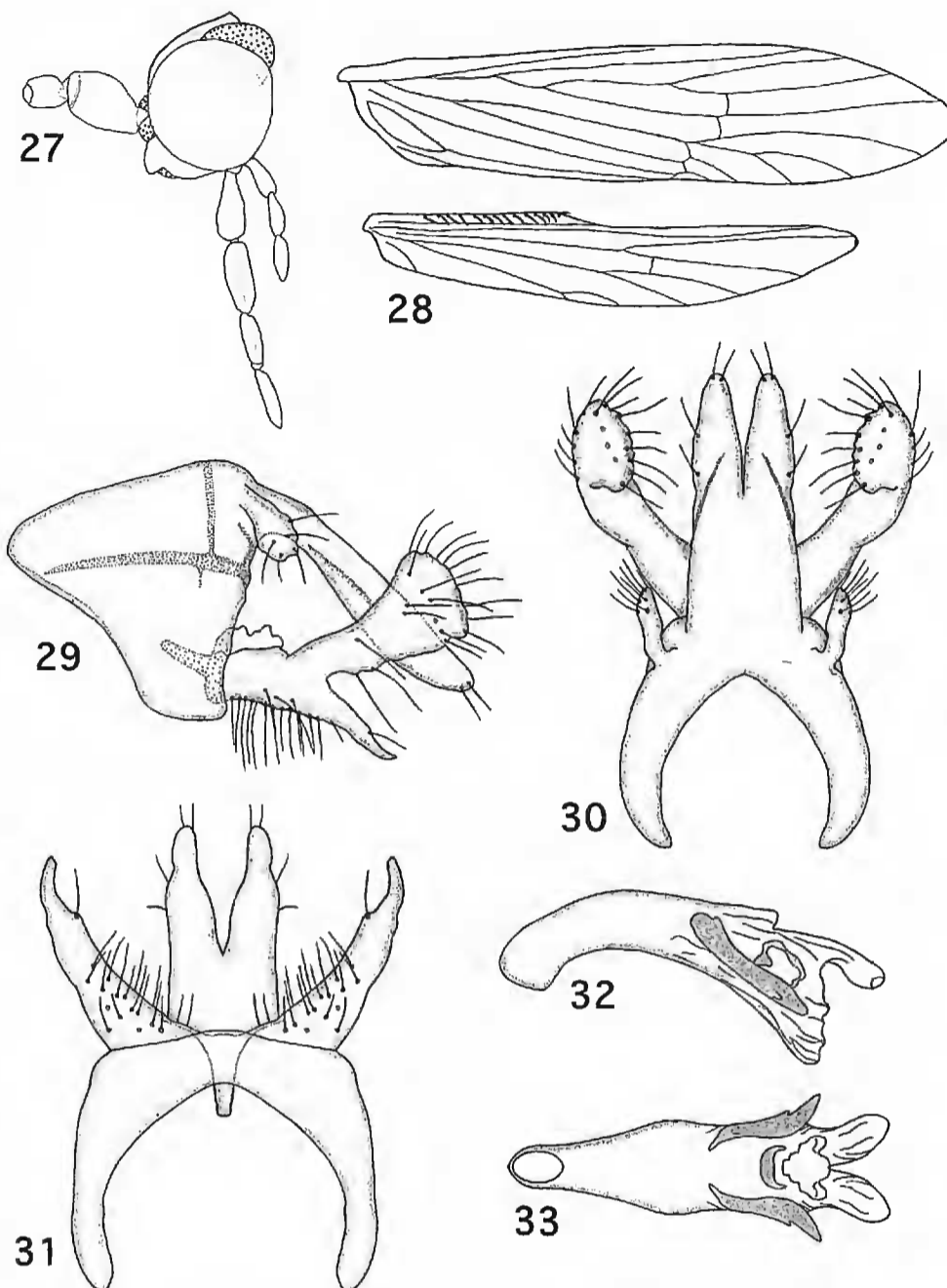
*Etymology.*—*azunensis*, refers to river at collection site.

*Material examined.*—see Types.

*HELICOPSYCHE DACKLESTENSIS* SCHEFTER AND JOHANSON, NEW SPECIES  
(Figs. 34–39)

*Types.*—Holotype, male: VIETNAM: *GIA LAI*, An Khe Dist., Dacklest River, 5.2 km NE Tram Lap on forest road, 28 Jun 1996, D. C. Currie, J. Swann, ROM 961102, UV light, 200 m upstream bridge, 1° rainforest, 900 m, 14°24' N, 108°33' E.

*Description.*—Male. Head: as in *Helicopsyche azunensis*, except vertex forming a smaller triangle.



Figures 27–33. *Helicopsyche azunensis* (male).

Figure 27. Head, lateral view.

Figure 28. Wings.

Figure 29. Genitalia, lateral view.

Figure 30. Genitalia, dorsal view.

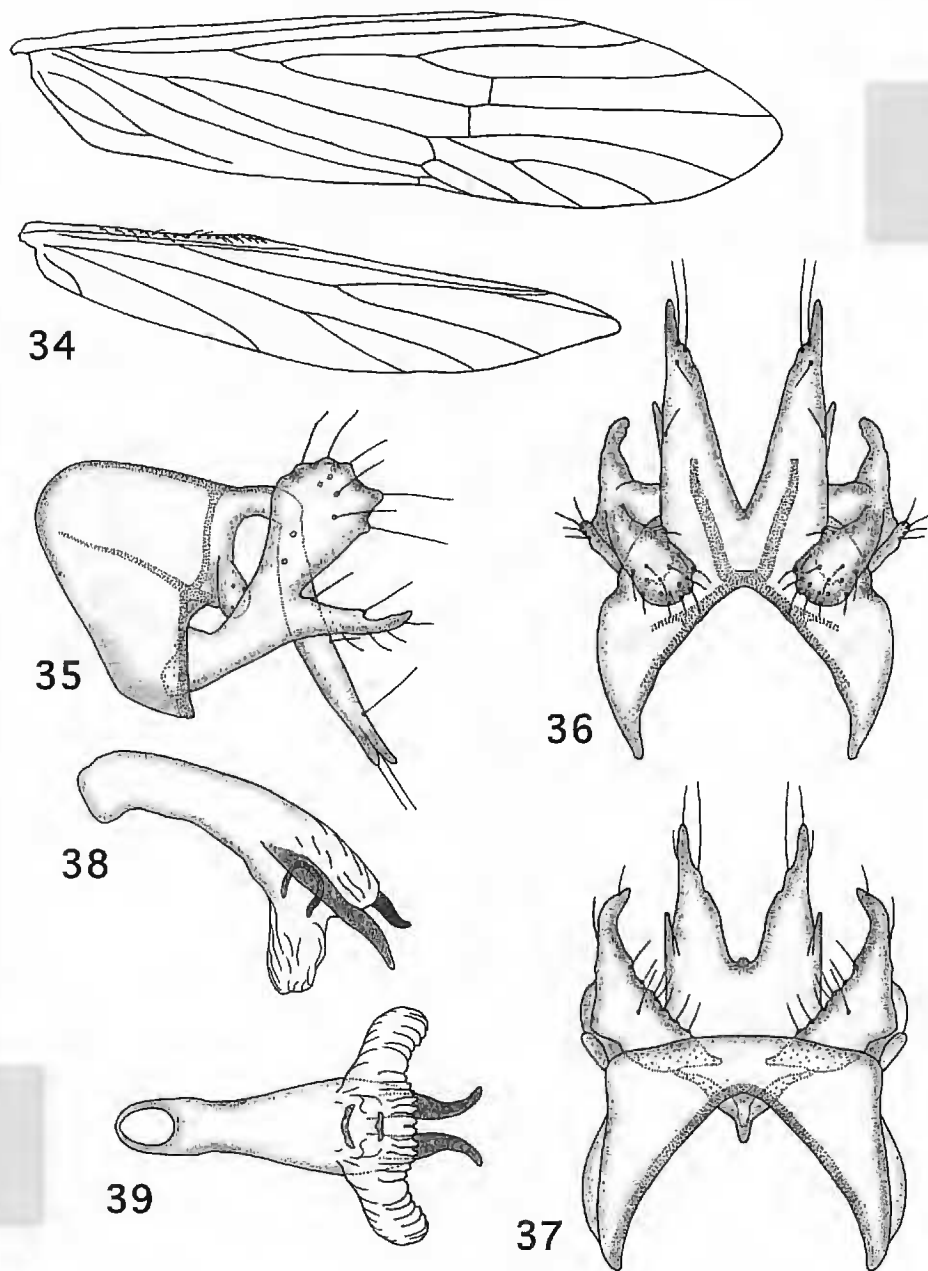
Figure 31. Genitalia, ventral view.

Figure 32. Phallus, lateral view.

Figure 33. Phallus, dorsal view.

Legs and pronotum as in *H. azunensis*. Wings (Fig. 34): fore wing length 2.7 mm, forks 1,2,3 and 5 present, fork 1 originating at distal one third of Dc, R<sub>2</sub> subequal to Dc, A<sub>1+2</sub> well separated from wing margin, does not reach wing margin; hind wing 2.1 mm; with 18 hamuli. Abdomen with well developed VIth sternal process. Genitalia: segment IX, lateral view (Fig. 35), subtriangular and longer dorsally, with well developed lateral apodeme. Gonocoxite divided into large primary and small secondary branch; primary branch in lateral view (Fig. 35) clavate with undulate apical margin; secondary branch slender, arcuate, notched at apex. Superior appendage originates medially on segment nine, directed ventrad, clavate in lateral view (Fig. 35); Xth tergum slender, slightly sinuate, strongly depressed in lateral view (Fig. 35), in dorsal view (Fig. 36) deeply bifurcate, each tapering lobe with a small ventrolateral process (Fig. 37); macrosetae absent. Phallus thick, slightly curved ventrally (Fig. 38) dorsoapical membranous endotheca expanded as posterior lobes with embedded paired slender sclerous processes curved apicolaterally (Figs. 38 and 39).

*Female and immature stages.*—Unknown.



Figures 34–39. *Helicopsyche dacklestensis* (male).

Figure 34. Wings.

Figure 35. Genitalia, lateral view.

Figure 36. Genitalia, dorsal view.

Figure 37. Genitalia, ventral view.

Figure 38. Phallus, lateral view.

Figure 39. Phallus, dorsal view.

*Diagnosis.*—*Helicopsyche dacklestensis* is most similar to *H. xenothoe* (Schmid) and can be separated from that and other species in this group by the slender and strongly arched Xth tergum, deeply bifurcate with small mesolateral processes, and the armature of the phallus.

*Etymology.*—*dacklestensis*, refers to river at collecting site.

*Material Examined.*—see Types.

#### DISCUSSION

*Helicopsyche khemoiensis* is most closely related to the North Korean *H. coreana* Mey. Both are restricted to the East Asian subregion (sensu Banareescu 1992), the two species comprising the subgenus *Galeopsyche* (Johanson 1998). Characteristics supporting monophyly of this group are (plesiomorphic states in parenthesis): reduction of the lateral pronotal setal warts (present, unreduced);



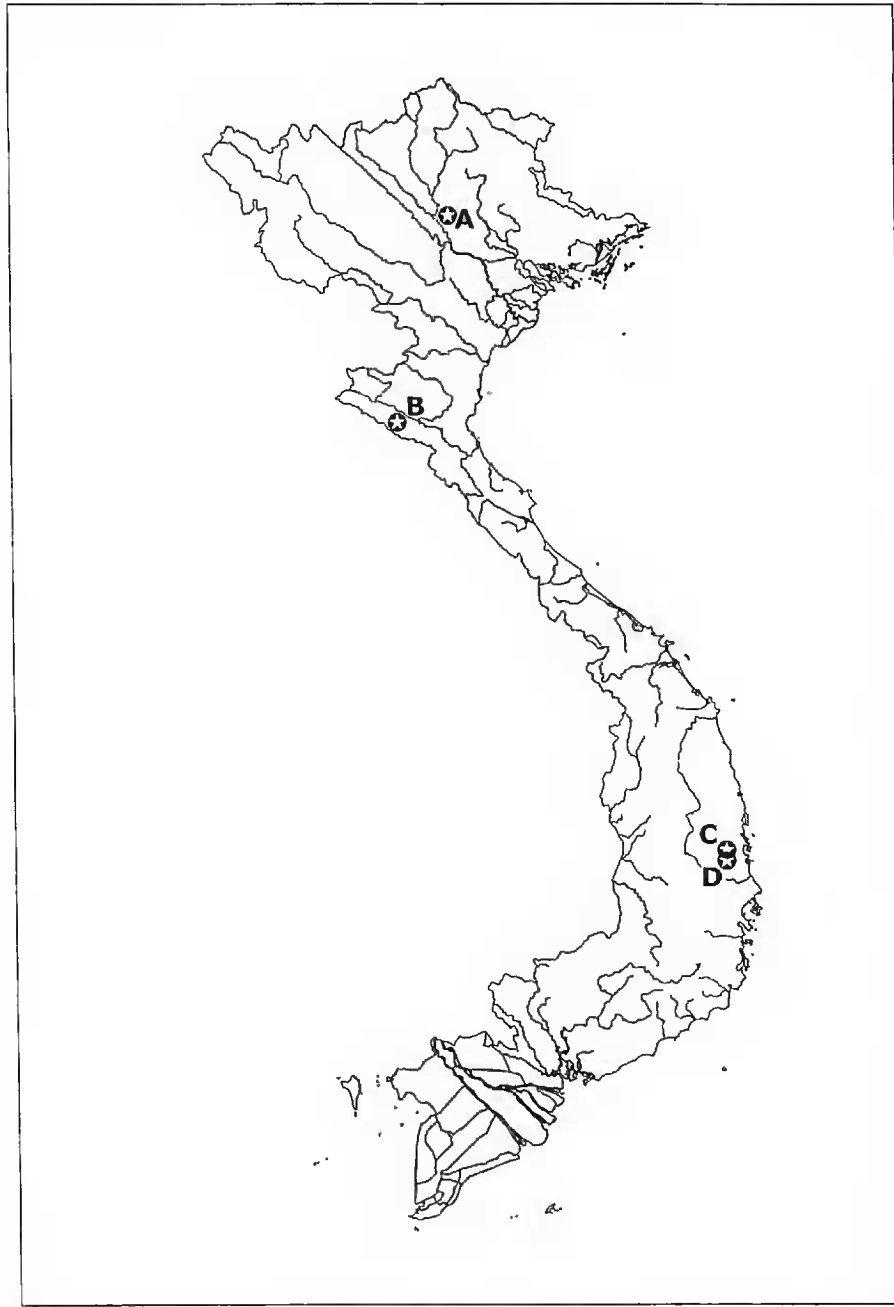


Figure 40. Collecting sites of Vietnamese *Helicopsyche*. A. *H. awudschgal* Malicky. B. *H. khe-moiensis*. C. *H. azunensis*. D. *H. dacklenstensis*.

fore wing crossvein  $R_{2+3}-R_{4+5}$  directed posterobasad (directed ventrad), and fore wing  $A_{1+2}$  meeting  $Cu_2$  or fusing with the posterior wing margin close to  $Cu_2$  (distant to  $Cu_2$ ). East Asian subgenus *Galeopsyche* and the South American subgenus *Cochliopsyche* are sister groups (Johanson 1998).

Species described in genus *Cochliophylax* (Schmid 1993) from northeastern India and Nepal were redesignated as a derived monophyletic clade within the subgenus *Helicopsyche* (Johanson 1998). *Helicopsyche azunensis* and *H. dacklenstensis* are closely related to the many *Cochliophylax* species described by Schmid, and together with them have 4-jointed maxillary palps, mesoscutal warts absent, narrow hind wings without crossvein M-Cu, and the gonocoxal secondary branch tapered and with an apical hook. *Helicopsyche azunensis* and *H. dacklenstensis* are considered sister species based on the presence of phallic endothecal sclerites. Their relationship to the remaining species in the group is as yet undetermined.

Distribution of the four known Vietnamese *Helicopsyche* species is shown in Fig. 40.

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